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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/649,256	08/27/2003	Satyavolu S. Papa Rao	TI-35916	7202
23494	7590	10/01/2004	EXAMINER	
TEXAS INSTRUMENTS INCORPORATED P O BOX 655474, M/S 3999 DALLAS, TX 75265			NGUYEN, THANH T	
			ART UNIT	PAPER NUMBER
			2813	

DATE MAILED: 10/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

CA

Office Action Summary	Application No.	Applicant(s)	
	10/649,256	PAPA RAO ET AL.	
	Examiner	Art Unit	
	Thanh T. Nguyen	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 06 July 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3-10 and 17-22 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1 and 3-6 is/are allowed.
- 6) ☒ Claim(s) 7-10 and 17-22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Arguments

Applicant's arguments with respect to claims 1, 3-10, 17-22 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 7-10, 17-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim (U.S. Publication No. 2002/0185671) in view of in view of Wolf "Silicon Processing for the VLSI ERA" vol. 1, pages 335-374 and Vaartstra et al. (U.S. Patent No. 6,074,945).

Referring to figures 1a-1f, Kim teaches a method for forming integrated circuit copper lines, comprising:

Forming a trench (19, called via hole) in a dielectric layer (14/15/16/17/18);

Forming a first metal layer (20/21, Pt/Ru/Ir/W) in the trench using physical vapor deposition (see paragraph 52) and a high atomic number metal (see figures 1C and paragraph

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52); Noted for the purpose of rejecting claim 17, wherein exposing the first metal layer (20) to a plasma treatment (see paragraph# 49).

Forming a second metal layer (23, Pt/Ru/Ir/W) in the trench over the first metal using chemical vapor deposition and a high atomic number metal (see figures 1C and paragraphs# 52); and

Filling the trench with copper by electroplating copper (26, see paragraphs# 67-69) directly on the second metal layer.

However, Kim does not teach forming a ruthenium layer using a plasma excitation power of 100-1000 Watts with a DC power to 4KW to 30KW applied to a sputter metal target, and flowing a vapor containing Ruthenium over a surface heated to between 100-350°C, and the thickness of the first metal layer is less than 50Å thick.

It is known in the art that PVD (Physical Vapor Deposition) including the step of plasma excitation (plasma treatment) to a sputter metal target (see Wolf, vol. 1, pages 335-374) (meeting claims 7, 17-18, 20).

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would depositing a metal layer (Ruthenium) by using PVD (Physical Vapor Deposition) including the step of plasma excitation to a sputter metal target in process of Kim as taught by Wolf because the process would easily control the film thickness and also provide a uniform thickness.

Vaartstra et al. teaches forming a Ruthenium layer by vapor process by depositing a layer at the temperature of about 150-350°C (see col. 4, lines 14-49) (meeting claims 7, 19).

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Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would form a Ruthenium layer by vapor process by depositing a layer at the temperature of about 150-350°C in process of Kim as taught by Vaartstra et al. because the process would provide a good step coverage.

Regarding to claims 9-10, 21-22, it would be obvious to one ordinary skill in the art to form a plurality of metal layers in the to fill the trench, since it is well-known in the art to repeat the same process for multiple effect. See *St. Regis paper, Co. V. Bemis Co. Inc.* 193 USPQ 8, 11 (7th circuit 1977).

The specific power range, temperature range, thickness range are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted In re Aller, the selection of reaction parameters such as temperature would have been obvious:

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed "critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

In re Aller 105 USPQ233, 255 (CCPA 1955). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmscher* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

Therefore, one of ordinary skill in the requisite art at the time the invention was made would have used any power range, temperature range, and thickness range suitable to the method in process of Kim in order to optimize the process.

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The specification contains no disclosure of either the critical nature of the claimed arrangement (i.e.- the power range, the temperature range, the thickness range) or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen limitations or upon another variable recited in a claim, the applicant must show that the chosen limitations are critical. In re Woodruff, 919 F.2d 1575, 1578 (FED. Cir. 1990).

Allowable Subject Matter

Claims 1, 3-6 are allowed. Because none of the prior art alone or in combination teaches a method of forming a first metal consisting of Ru, Ir, and Rh by PVD, forming a second metal consisting of Ru, Ir, and Rh in contact with the first metal by using CVD method, and filling the trench with copper by electroplating directly on the second metal.

Response to Arguments

Applicant's arguments filed on 7/6/04 have been fully considered but they are not persuasive.

Rejection based on claims 1-6 are withdrawn.

Applicant contends that none of the prior art taught or suggested the conditions that requires by sputtering from a metal target. In response to applicant that the applicant must show that the chosen limitations are critical by showing the unexpected results of forming the metal layer by the claimed conditions.

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Applicant contends that none of the prior art taught or suggested the plasma treatment. In response to applicant that Kim as well as Wolf teaches plasma treatment (see paragraph# 49 in Kim) or the step of plasma excitation (plasma treatment) to a sputter metal target (see Wolf, vol. 1, pages 335-374).

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (571) 272-1695, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:00AM to 3:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached on (571) 272-1702. The fax phone number for this Group is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956 (**See MPEP 203.08**).



Thanh Nguyen
Patent Examiner
Patent Examining Group 2800

TTN